



Groundwater salinity and hand dug wells in Ampara, Sri Lanka

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During the clean up after the tsunami, well pumping was sometimes carried out incorrectly. Repeated emptying of the well, intended to reduce salinity levels, might instead have led to saltwater intrusion into the aquifer.

The *tsunami* of December 2004 resulted in widespread saltwater contamination of the coastal aquifers in the east and south of Sri Lanka. Research was conducted with Oxfam GB in Ampara District between July and October 2006 to investigate groundwater salinity and the recovery of a sample of 40 wells that had been monitored since the completion of a well-rehabilitation programme in November 2005.

Even 18 months after the *tsunami*, salinity levels remained high in some areas of Ampara District, and the study aimed to identify local hydrogeological characteristics that could explain this and, given these conditions, identify the appropriateness and effectiveness of the well rehabilitation programme.

Aquifer recovery

This study found rainfall to be most influential in reducing the salinity of 40 wells monitored by Oxfam. To explore the significance of soil type in the recovery of the aquifer, samples were taken from well sites with the highest and lowest salinity levels in two coastal towns, Akkaraipatu and Thirukkivil. It was found that wells with a higher electrical conductivity (EC) also had a greater percentage of non-sand particles in the soil structure, though results indicated this relationship was stronger in Akkaraipatu.

It is important to highlight, however, that average rainfall in Ampara District since the *tsunami* has been considerably lower to that prior to the event.

We don't know to what extent salinity levels would have been further

reduced had the monthly rainfall totals been closer to average, but it would arguably have been greater. Without pre-*tsunami* data on groundwater salinity, it is also impossible to determine to what extent the aquifer has recovered since.

Well cleaning as an emergency response

In their immediate response to the flooded wells and the saltwater contamination, Oxfam and a number of NGOs provided tankered water to the affected communities. In addition, IWMI¹ produced a detailed report providing insight to the nature of Sri Lanka's coastal aquifers, and brought to light the risks of saline intrusion resulting from the continuous pumping of wells. Given that the majority of wells requiring rehabilitation were within 800m of the sea, it would be difficult to avoid these risks unless the clear guidelines about well cleaning were adhered to. These accompanied their report, and particular attention was to be paid to pumping rates, and the amount of water removed from the well. Similar studies were also conducted by UNICEF², and a number of guidelines were issued by different agencies, which all followed similar principles.

In March 2005, an extensive well-cleaning programme began in an effort to restore the community water supply in Ampara, which would also allow the phasing out of water tankering. Well cleaning involved the dewatering and removal of debris and sludge from thousands of wells along the coast. There are, however, recollections that

some organizations were cleaning and pumping out wells before this time, in an uncoordinated and irresponsible manner. They were reported to have over-pumped these wells, causing some to collapse, and may have also contributed to saline intrusion. With regards to the coordinated effort, the revised guidelines clearly stated that pumping out should *not* be carried out with the aim of reducing salinity. Despite this, it was clear that this had been misunderstood, since some teams were carrying out repeated rounds of well cleaning.

Criticisms of the well-cleaning programme

Overall, there were many criticisms of the well-cleaning programme.

- *Inappropriate recommendations.* The original well-cleaning guidelines came from the WHO³, and were inappropriate to local conditions; for example, they recommended emptying the well completely. These guidelines were replaced only in May 2005, and provided strong recommendations of what not to do. Was this too late?
- *Lack of monitoring.* There were organizations cleaning wells before May 2005, and these efforts were uncoordinated, unmonitored, and no EC data were collected during the procedures to evaluate effectiveness or to discover whether any saline intrusion had been caused. Once the coordinated programme began, there was a lack of follow up to monitor and assess the results of the data collected. Whose responsibility was this?

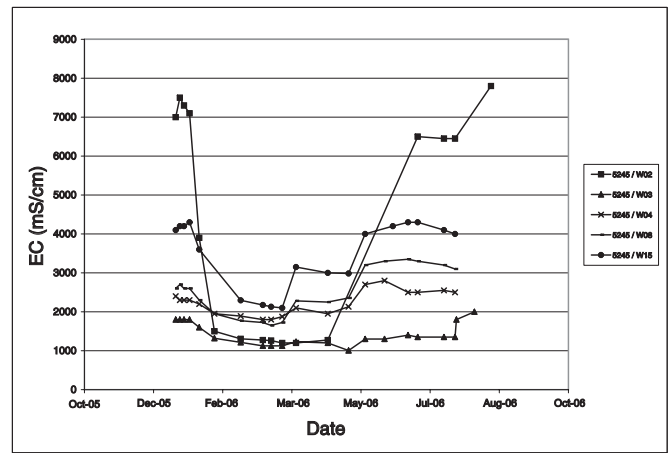
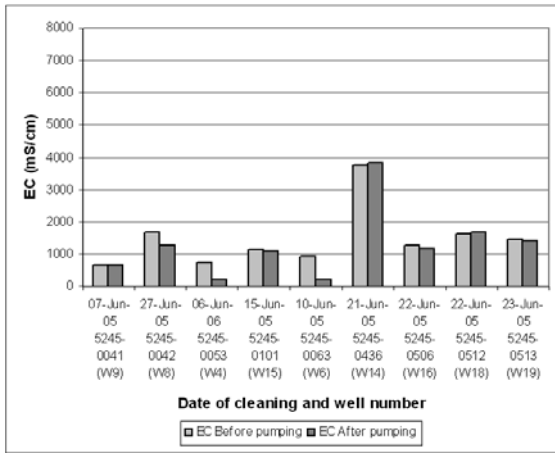


Figure 1. Response of 9 of the monitored wells in Thirukkivil to well cleaning

Figure 2. Conductivity monitoring from 20 wells in Thirukkivil

- *Unspecific guidelines.* The revised guidelines recommended a ‘low pumping rate’, but what is ‘low’?
- *Public misperceptions.* Unhappy with the continued salty taste of the water, some households conducted their own well cleaning under the assumption that it would reduce salinity in their well (one family had dewatered their well 11 times). Perhaps NGOs had not communicated the aims of their activities, or had even misunderstood the aims themselves?
- *Rehabilitation.* As part of a well rehabilitation programme, little or no physical rehabilitation was carried out to prevent well water being contaminated by other sources, e.g. repairing well aprons and covers.
- *Heightened expectations.* Perhaps unnecessary concerns were raised when beneficiaries were informed that their well was not fit to drink due to salinity (when perhaps it was no different to what it was before), and they were then given the expectation that well cleaning would solve this problem.

Despite these criticisms, the programme was successful in removing the vast quantities of debris, not only from within, but also around the well. The pumping out had also encouraged recharge and circulation of water within the aquifer to help reduce turbidity within the well. In terms of salinity reduction (though this was not supposed to be the aim of the programme),

Figure 1 shows how a small sample of wells responded to the first round of well cleaning in Thirukkivil.

No significant reduction in EC levels resulted from the pumping out. However, perhaps any slight reduction had encouraged NGOs to repeat the cleaning process. Despite this, there were many wells that saw an increase or no change at all in their EC level. It is interesting to contrast these results to the reaction from the community, where household interviews showed that 61 per cent of the sample felt that the well cleaning had improved the taste of the well water (i.e. the salinity). (In comparison, however, 92 per cent said that they believed that monsoon rains had improved the taste.) The impression gained from the community was that they believed drinking salty water was dangerous, and that well cleaning would reduce the salinity of their well water, which encouraged them to carry out their own dewatering. This is an important example of a miscommunication between the NGOs and well owners.

Since the completion of the programme, Oxfam began monitoring 40 wells in Akkaraipatu and Thirukkivil, and Figure 2 shows how EC levels changed over time. Figure 2 demonstrates a noticeable reduction in salinity between December 2005 and February 2006 as a result of the increased rainfall. Salinity levels steadily rose during the dry season from May 2006, although this was more apparent in Akkaraipatu. There are a number of wells in both

towns that continue to maintain high conductivity levels. In Akkaraipatu, 60 per cent of the wells in this sample are below the accepted EC level of 2000mS/cm, but only 25 per cent in Thirukkivil.

Conclusion

The IWMI guidelines issued in May 2005 stated that wells should not be pumped out with the intention of reducing salinity. If the goal of the programme was to simply remove the debris from the wells and pump out a percentage of water to remove sludge and contaminated water, it was a success. On the other hand, why were most wells cleaned more than once if the debris and sludge had already been removed after the first round? This not only suggests a misunderstanding amongst the stakeholders in the rationale behind the programme, but also that the salinity problem in this area could have been prolonged by continued pumping.

References

- 1 IWMI (2005) *Tsunami impacts on shallow groundwater and associated water supply on the east coast of Sri Lanka: A post-tsunami well recovery support initiative and an assessment of groundwater salinity in three areas of Batticaloa and Ampara Districts*, IWMI, Colombo.
- 2 UNICEF (2005) *Consequences of the tsunami on the coastal aquifer in eastern Sri Lanka: Guidelines on wells rehabilitation*, UNICEF Trincomalee, May 2005.
- 3 WHO(2005) *Technical Notes for Emergencies*, Technical Note No.1, Draft revised: 07.01.05